



DORTHY REESE  
FIELD COILS

MODEL

PS/PSE-300

FIELD POWER SUPPLY

INSTRUCTION MANUAL

M706543A

Serial No.

55 and Up

0279



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### SECTION I - INTRODUCTION AND GENERAL INFORMATION

#### PROPRIETARY NOTICE

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### SECTION II - THEORY OF OPERATION

### SECTION III - MAINTENANCE

#### CUSTOMER SERVICE

If any difficulty is encountered in implementing the instructions in this manual, contact the Customer Service Department, Ling Electronics, Anaheim, California at (714) 779-1900. Please give the equipment model number, the serial number, the conditions of use, and a description of the problem.

Ling Electronics maintains a staff of qualified, factory-trained field engineers with years of experience in the installation, maintenance, repair, and calibration of test systems. These field service representatives are available for consultation on special problems concerning utilization or application of Ling Electronics equipment.



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## SECTION I

### INTRODUCTION AND GENERAL INFORMATION

#### 1.1 INTRODUCTION - MANUAL

This manual contains general information on and detailed instructions for installing, operationally testing, troubleshooting, and maintaining the Ling Air-Cooled Field Power Supply, Model PS/PSE-300. The PSE indicated the power supply with enclosure. Reference Figure 1-1 and 1-2.

##### 1.1.1 Scope of Manual

This manual presents a brief description of the units major components and subassemblies and the contribution of each to the overall operation of the unit.

Personnel and equipment safety features and interlocking circuits are discussed along with a detailed description of the overall circuit operation and theory of operation.

Ling drawings and photographs are presented to point out the approximate physical location of unit components along with a schematic drawing of the unit.

Troubleshooting techniques, preventive maintenance schedules, supporting documentation, and options are detailed in Sections IV, V, and VI.

##### 1.1.2 Arrangement of Manual

This manual is presented in six sections which are as follows:

- Section I - Introduction and General Information
- Section II - Installation and Operation
- Section III - Principles of Operation
- Section IV - Maintenance
- Section V - Support Documentation
- Section VI - Options

#### 1.2 INTRODUCTION - LING MODEL PSE-300 FIELD POWER SUPPLY (FPS)

The Ling Model PSE-300 is used to provide excitation voltage to the field and degaussing coils in the Ling Model D300 Shaker.

The unit has been designed and built with provisions for operating with input voltages ranging from 420 to 480 V, three-phase, 50/60 Hz.

Ling Model PSE-300 FPS's capable of operating with other input voltages are available as standard options, as explained in Section VI.



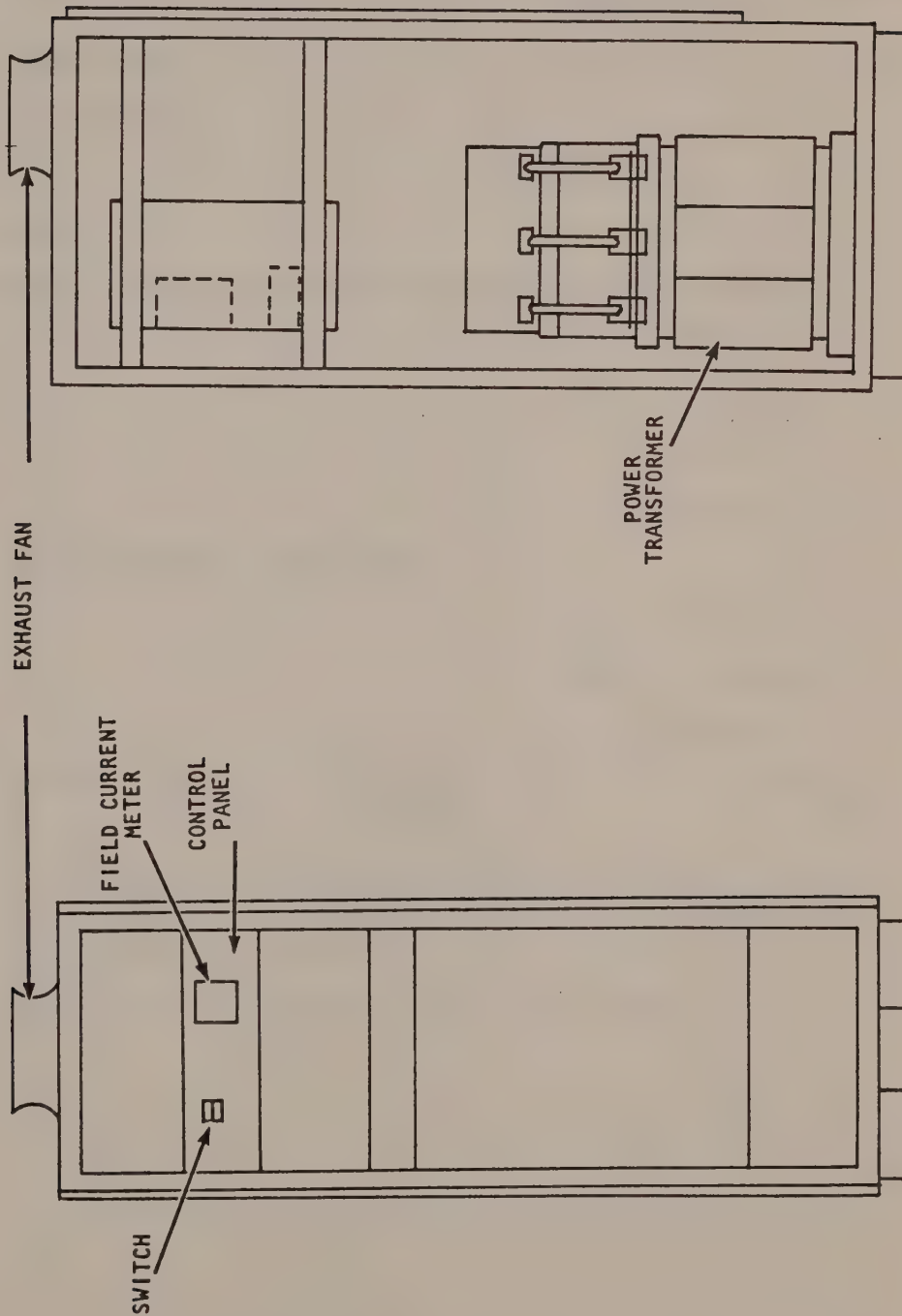


Figure 1-1. Ling Air-Cooled Field Power Supply Front View

Figure 1-2. Ling Air-Cooled Field Power Supply Rear View



### 1.2.1 Reference Data

Leading particulars for the standard Ling Model PSE-300 Field Power Supply are:

|                                  |                                    |
|----------------------------------|------------------------------------|
| Input Voltage . . . . .          | 420 to 480 V three-phase,<br>60 Hz |
| Nominal Input Power . . . . .    | 25 kVA                             |
| Nominal Output Voltage . . . . . | 90 V                               |
| Nominal Output Current . . . . . | 250 A                              |
| Cooling Agent . . . . .          | Forced Air                         |

### 1.2.2 Weight and Physical Dimensions (Approximate) Power Supply

|                  |                    |
|------------------|--------------------|
| Weight . . . . . | 350 lb (1557 N)    |
| Height . . . . . | 27-1/2 in (699 mm) |
| Width . . . . .  | 17 in (432 mm)     |
| Depth . . . . .  | 10 in (254 mm)     |

### 1.2.3 Cabinet Dimensions (Approximate)

|                  |                    |
|------------------|--------------------|
| Height . . . . . | 71 in (1803 mm)    |
| Width . . . . .  | 23-1/2 in (597 mm) |
| Depth . . . . .  | 35 in (889 mm)     |

#### **WARNING**

The voltages encountered in the FPS are LETHAL! It is highly recommended that only Class A Electrical Journeyman, or equivalent personnel, be permitted to attach operating and control power to the FPS.







SECTION II  
INSTALLATION AND OPERATION

2.1 INSTALLATION

The Ling Model PSE-300 is mounted in a single-bay equipment console, as shown in Ling drawing 705083. Figures 2-1 and 2-2 are line presentations of the FPS showing the location of major components and subassemblies of the FPS.

Figure 2-3 is a schematic presentation of a typical installation to provide external operating power with fuse protection to the FPS.

Figure 2-4 is the electrical schematic for the PSE-300 FPS connected to operate with an input voltage of 480 V, three-phase, 60 Hz.

Physical location the PSE-300 FPS Console should be as close as feasible to the D300 Shaker in order to keep high current cabling between the PSE-300 FPS and the D300 Shaker as short as possible to minimize IR losses.

2.1.1 Connecting the PSE-300 to the SSPA

NOTE

In the following description, it is assumed that the PSE-300 is to be operated with a standard Ling Solid State Power Amplifier.

Using 18 AWG wiring, interconnect the PSE-300 FPS and the SSPA as follows:

| Terminals | Function              | SSPA Control Distribution Card Terminals |
|-----------|-----------------------|------------------------------------------|
| TB2-1     | 115 VAC (Low)         | TB3-30                                   |
| TB2-2     | 115 VAC (High)        | TB3-27                                   |
| TB2-3     | Field-On (High)       | TB3-7                                    |
| TB2-4     | Field-On (Low)        | TB3-8                                    |
| TB2-5     | Door Interlock (High) | TB3-37                                   |
| TB2-6     | Door Interlock (Low)  | TB3-38                                   |
| TB2-9     | 115 VAC (High)        | TB3-26                                   |

2.1.2 Connecting the PSE-300 to the D300 Shaker

Using at least two #1/0 cables, in parallel, connect TB3-E(+) on the PSE-300 on the (+) field coil input on the D300 Shaker. Using at least two #1/0 cables, in parallel, connect TB3-F(-) on the PSE-300 to the (-) connection on the field coil in the D300 Shaker.



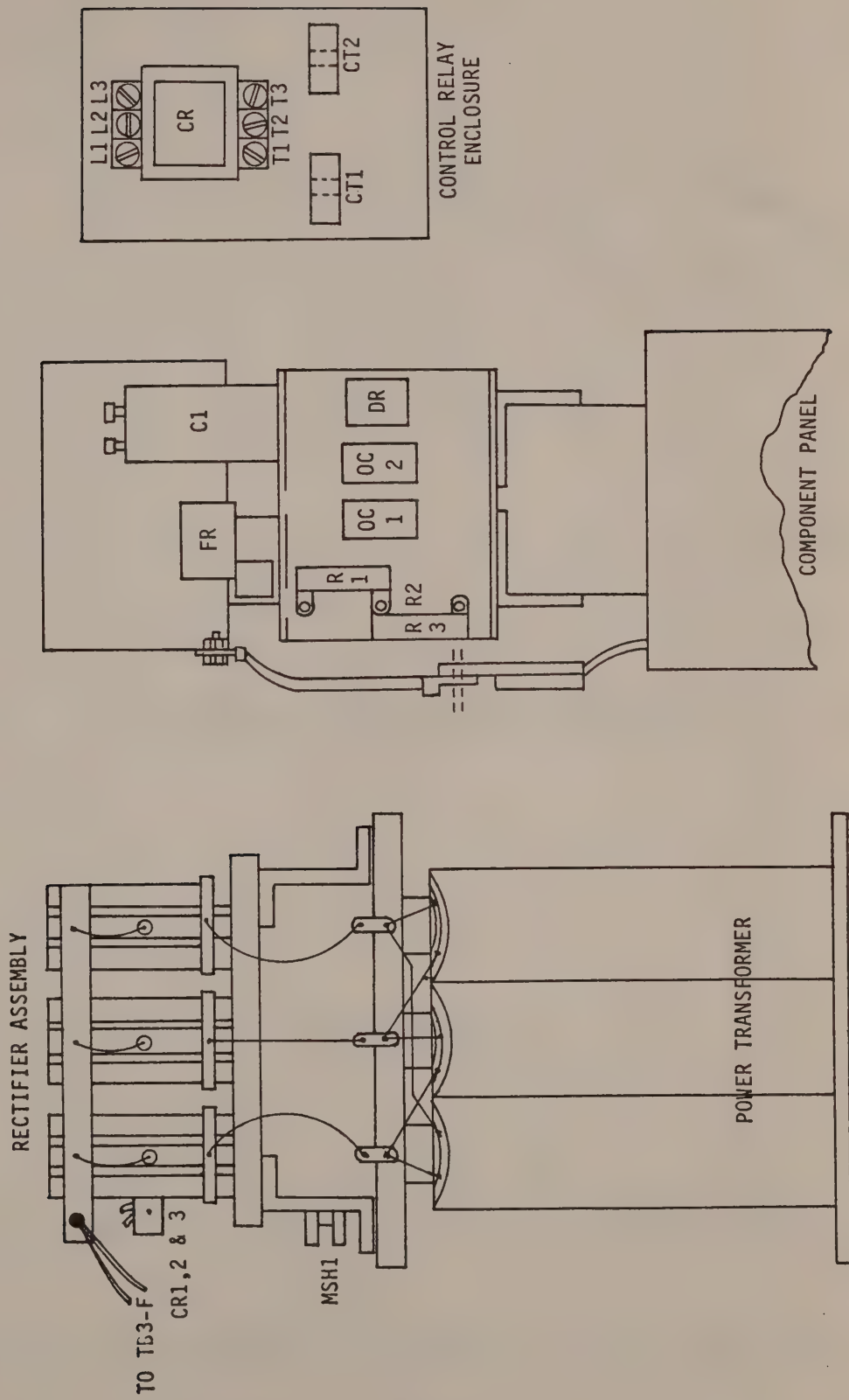


Figure 2-1. Assemblies of the PSE-300 FPS - Front View



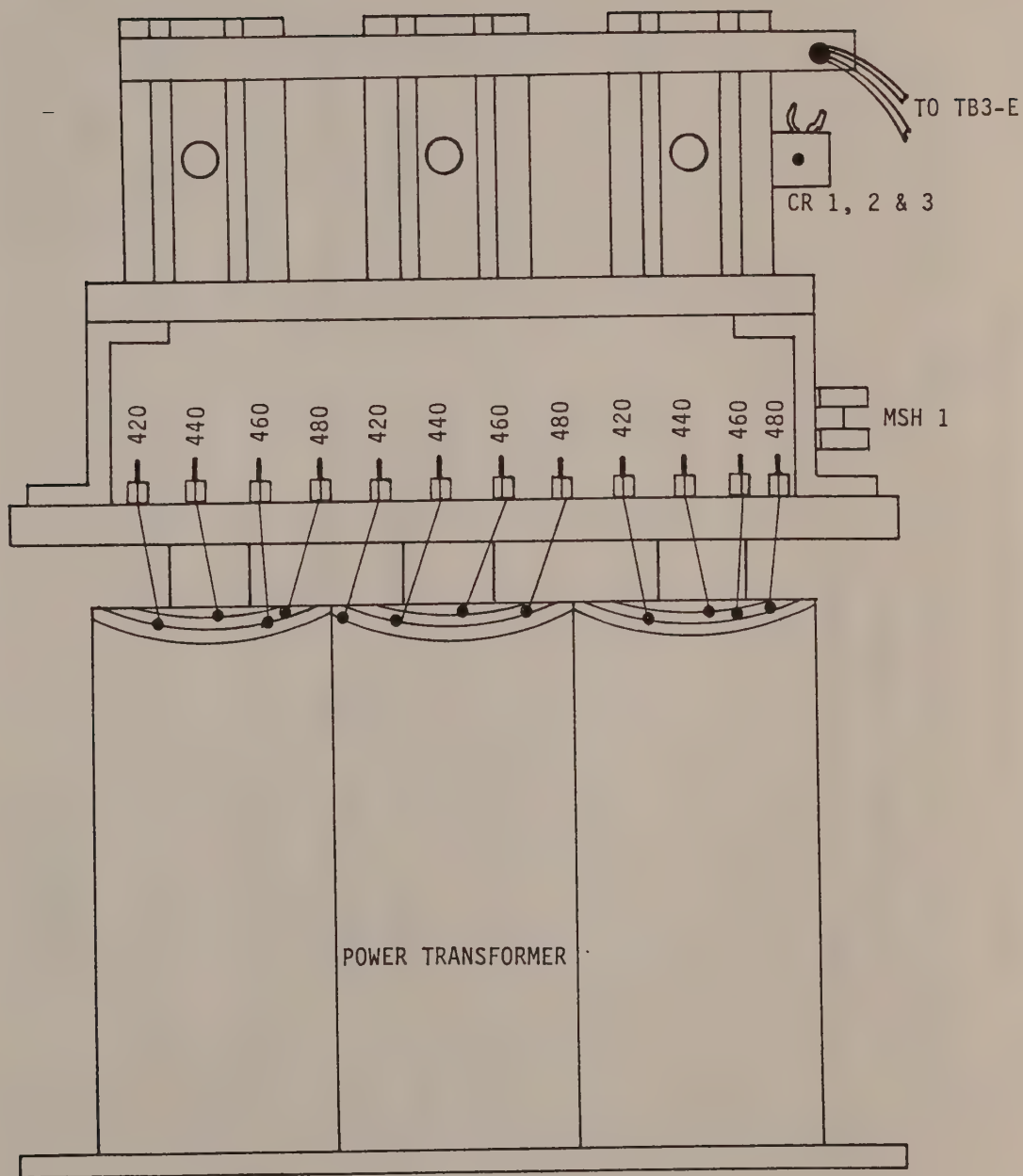
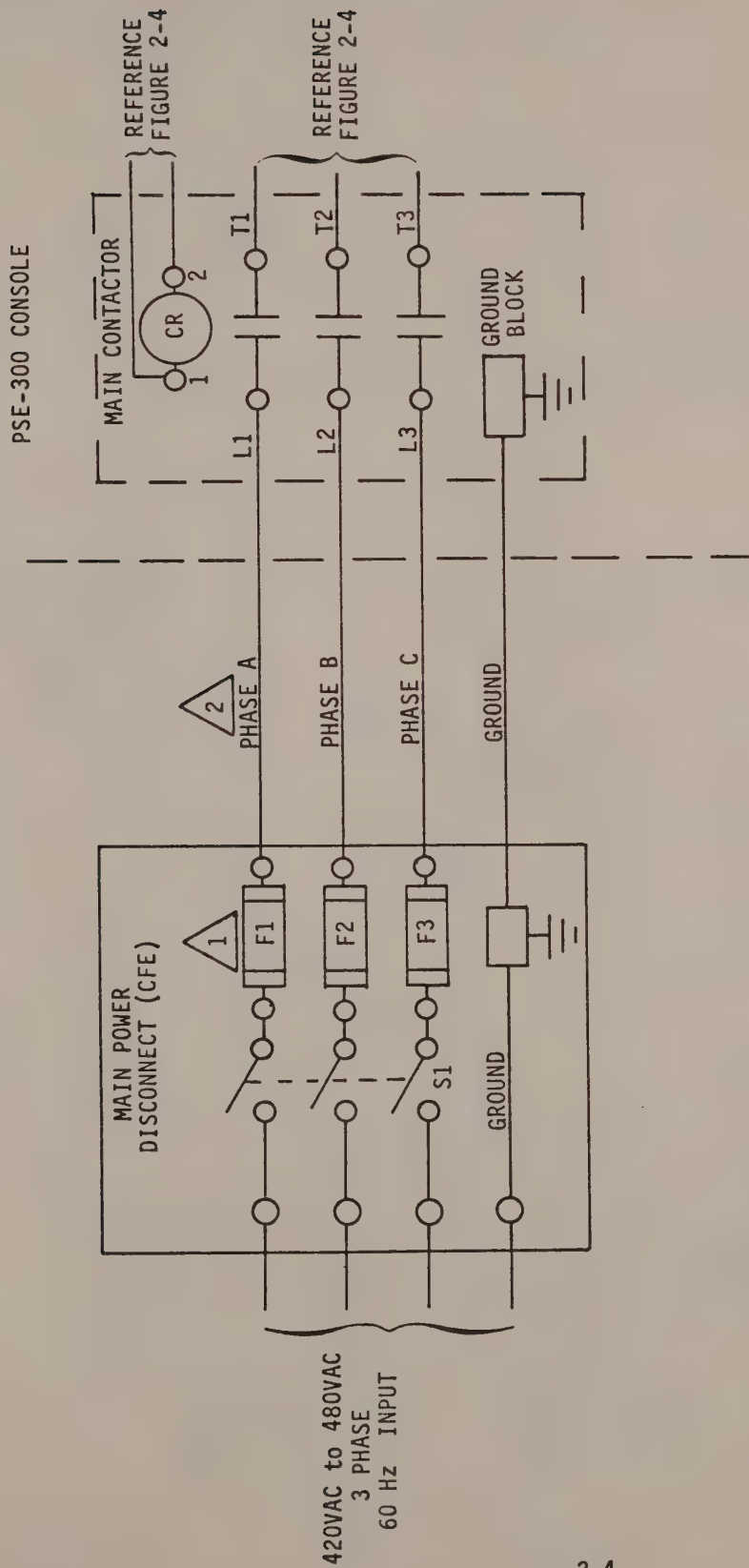


Figure 2-2. Transformer/Rectifier Assembly - PS-300 FPS - Rear View





1. For voltage shown use 35A, 600V dual-element
2. For voltage shown all wiring is 8 AWG THW
3. Refer to Ling Drawing 705083 for fuse and wire size for other input voltages

Figure 2-3. Typical Input Power Hookup for PSE-300







### 2.1.3 Connecting External Operating Power to the PSE-300 FPS

To connect the three-phase operating power to the PSE-300 FPS, proceed as follows.

1. Verify that the FPS transformer is correctly strapped to accept and operate with the three-phase voltage to be used. Figure 2-4 shows the input taps to be used for various input voltages for the Ling Model PT-451 Power Transformer, which is used with 60 Hz input voltages. The Ling Model PS-1271 Power Transformer, which is used with 50/60 Hz input voltages, is adequately marked for 208 to 240 V and 380 V, three-phase, 50/60 Hz input voltages (reference drawing 705085 for input taps).
2. Using an appropriate electrical, hand-operated main power disconnect switch unit with fuses and wire, as described in Figure 2-3, connect external three-phase operating power to the PSE-300 FPS as shown in Figure 2-3. Observe all applicable national and local codes.

### 2.1.4 Special Electrical Hookup

If requested at time of purchase, Ling Electronics, Inc., supplies detailed system interconnect drawings and schematics to enable Customer to connect the PSE-300 FPS with existing systems, special shaker, and/or customized operation as required by the Customer.

## 2.2 OPERATIONAL CHECKOUT

After the Model PSE-300 FPS has been installed as shown on the cognizant Ling system interconnect diagram, or as described in paragraph 2.1, above, use the following procedure to verify the operation of the FPS.

1. Connect a dc voltmeter, paragraph 4.2, across terminals TB3-E(+) and TB3-F(-) in the FPS. Prepare the meter to read up to 150 V dc.
2. Set the ON-OFF-BYPASS switching on the FPS control panel to the ON position. See Figure 2-5.

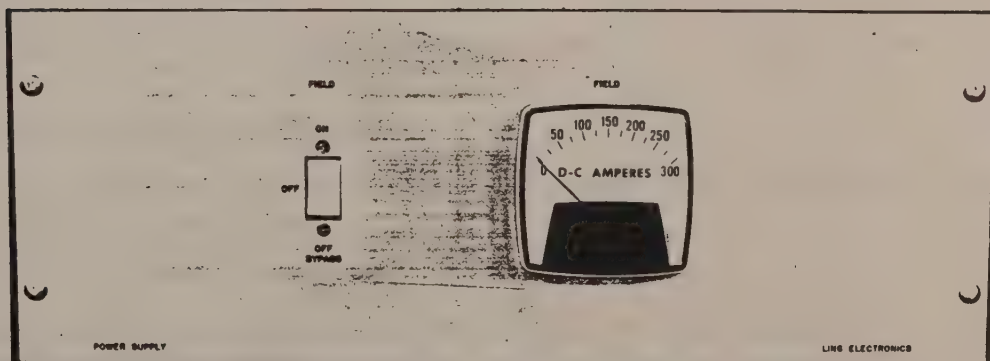


Figure 2-5. PSE-300 FPS Control Panel



3. Close the main power disconnect switch, S1, in Figure 2-3.
4. Energize the Ling Solid State Power Amplifier (SSPA), as recommended in the SSPA operations and maintenance manual, to the point where the control voltage is ON and verify the following:
  - a. The dc voltmeter, installed in step 1, above, indicated 90 to 110 V dc.
  - b. The field current meter on the FPS control panel indicates 250 to 330 A.
  - c. The exhaust fan on the FPS console is operating and air is being exhausted from the FPS enclosure.

NOTE

The initial voltage and current outputs of the PSE-300 will be 20 to 30 percent higher than nominal, but will stabilize to nominal values in 5 to 10 minutes after initial turn-on.

5. Remove operating power from the SSPA and the FPS and disconnect the voltmeter installed in step 1, above.
6. Disconnect and isolate the external wire from terminal TB2-5 or TB2-6 in the FPS console. These wires were installed in paragraph 2.1.1, above. Verify the following:
  - a. The SSPA cannot be energized.
  - b. The SSPA interlock status display indicates that a DOOR is open.
  - c. The FPS cannot be energized.
7. Remove operating power from the SSPA and the FPS and reconnect the wire removed in step 6, above.
8. Disconnect and isolate the external wire from TB2-3 or TB2-4 in the FPS console and verify the following:
  - a. The SSPA cannot be energized.
  - b. The SSPA interlock status display indicates that the SHAKER FIELD SUPPLY is inoperative.
  - c. The FPS cannot be energized.
9. Remove operating power from the SSPA and the FPS and reconnect the wire removed in step 8, above.



10. Disconnect and isolate the external wire from terminal TB2-1 or TB2-2 and verify the following:
  - a. The SSPA cannot be energized.
  - b. The SSPA interlock status display indicates that the SHAKER FIELD SUPPLY is inoperative.
  - c. The FPS cannot be energized.
11. Remove operating power from the SSPA and FPS and reconnect the wire removed in step 10, above.
12. Set the ON-OFF-BYPASS switch on the FPS control panel to the BYPASS position.
13. Apply operating power to the SSPA and FPS.
14. Energize the SSPA up to where the control power is ON. Verify the following:
  - a. The SSPA will energize and interlock status display for SHAKER field supply will be ON.
  - b. The FPS is NOT activated and the FPS FIELD CURRENT METER indicates zero current.

NOTE

This bypass feature on the FPS is useful when the servicing technician wishes to operate the SSPA at moderate output but keep the shaker armature from normal excursions. See the operation and maintenance manual on the D300 Shaker for other details.

15. Deenergize the SSPA and remove operating power from the SSPA and FPS.

### 2.3 OPERATING THE PSE-300 FPS

Normally, the three-phase operating power for the PSE-300 FPS is provided with a hand-operated main power disconnect switch and protective fuses as shown in Figure 2-3. Thus, when operating the PSE-300 FPS, the operator must ensure that operating power is available to the FPS unit.

If operating power is available to the FPS, operation of the unit is automatic and requires no action on the part of the system operator.

When the FPS ON-OFF-BYPASS switch is in the ON position, the FIELD ON interlock ensures that the system cannot be operated unless the FPS is functioning properly.

It is highly recommended that the operators of systems using the PSE-300 FPS physically check the field current meter reading immediately after energizing the unit.



## SECTION III

### THEORY OF OPERATION

#### 3.1 CIRCUIT THEORY

When the Ling Model PSE-300 FPS has been installed and connected, as recommended in paragraph 2.1, the operation of the unit is as explained in the following paragraphs.

##### 3.1.1 Three-Phase Operating Power

Three-phase operating power is available at terminals L1, L2, and L3 on the FPS main contactor when the main power disconnect switch, S1 on Figure 2-3, is closed.

##### 3.1.2 Control Power

Control power in the form of 115 V, single-phase, 60 Hz is applied across terminals TB2-1 (low) and TB2-2, -9 (high) in the FPS console when the CONTROL POWER in the associated SSPA is turned ON and system interlocks are closed.

##### 3.1.3 FPS Exhaust Fan

The FPS exhaust fan motor, B1 on Figure 2-4, is activated whenever the control voltage is present across terminals TB2-1 and TB2-2 in the FPS console.

##### 3.1.4 Control Circuit Operation (Figure 2-4)

When control power is applied across terminals TB2-1 and TB2-2, the low side of the control voltage is connected to terminal 1 of the FPS main contactor control relay (CR) and the delay relay (DR). The high side of the control voltage is applied through terminal TB1-9, one set of closed contacts on the ON-OFF-BYPASS switch, N.C. contacts of overcurrent relay OC2 and N.C. contacts of overcurrent relay OC1 to N.O. contacts of delay relay.

Fifteen seconds after the delay relay, DR, is energized, its N.O. contacts (DR1) close to apply the high side of the control power to the FPS main contactor control relay (CR). See paragraph 3.1.5. When the 15 seconds have elapsed, control relay CR is energized to activate the FPS main contactor and apply three-phase operating power to the primary of the FPS main power transformer.

##### 3.1.5 Fifteen-Second Turn-On Delay in FPS

This delay is introduced to allow any associated shaker cooling unit to get shaker coolant pressure and flow stabilized before applying shaker field voltage.



### 3.1.6 Power Supply Operation (Figure 2-4)

The FPS main power transformer is a Ling Model PT-451 step-down transformer which has a wye-connected primary and a delta-connected secondary. The voltage across the secondary winding is nominally 65 VAC.

The output of the delta-connected secondary of the FPS main transformer is connected to a bridge-connected combination of transient voltage suppressors CR1, CR2, and CR3 which protect the supply from surges and/or transients in the supply line. The output of the secondary winding of the FPS main power transformer is connected across a bridge rectifier network consisting of six rectifier diodes, as shown in Figure 2-4. The positive output (90 V) of the bridge rectifier is connected through meter shunt MSH-1 to terminal TB3-E(+) in the FPS console.

The common or negative output of the bridge rectifier is connected directly to terminal TB3-F(-) in the FPS console.

Also connected across the output of the bridge rectifier is filter capacitor C1 and parallel-connected surge current limiting resistors R2 and R3.

### 3.1.7 Interlock and Safety Circuits

The following interlock and safety circuits are provided in the Model PSE-300 FPS.

3.1.7.1 Field Relay - The field relay (FR) and its current limiting resistor R1 are connected across the output of the bridge rectifier. Thus, this relay cannot be activated unless there is sufficient voltage from the bridge rectifier.

N.O. contacts FR1 on this relay are part of a series circuit across terminals TB2-3 and TB2-4, which are used to interlock the power-up sequence of the SSPA. Thus, if there is no output from the bridge rectifier, relay FR will not be energized and the FIELD ON series circuit across terminals TB2-3 and TB2-4 will be incomplete and the SSPA will be prohibited from being energized. The interlock status display on the SSPA will indicate a FIELD POWER SUPPLY fault.

3.1.7.2 Control Relay - Auxiliary Contacts - A set of auxiliary contacts CR1 (aux) on the control relay (CR) is wired as a part of the FIELD ON series connected circuit described in paragraph 3.1.7.1, and operates to shut down the SSPA as previously described in paragraph 3.1.7.1.

3.1.7.3 Overcurrent Relays - Control transformers CT1 and CT2 monitor the current in phase A and phase C of the three-phase input power to the FPS main power transformer. N.C. contacts of these two control transformers form part of the series circuit for the high side of the control voltage to the delay relay and control relay operating coils.

If excessive current flows in either phase A or phase C of the input power, the associated overcurrent relay will activate to remove the control voltages from relays DR and CR, and shut down the field power supply.

The control relay, CR, and field relay, FR, will deenergize and operate to shut down the SSPA as explained above.



3.1.7.4 Field Relay Auxiliary Contacts - Normally open auxiliary contacts FR2 on the field relay are connected to terminals TB2-7 and TB2-8 in the FPS console as spare contacts and may be used by the Customer as desired.

#### 3.1.8 Field Current Meter

The field current meter on the front panel of the FPS control panel is connected through resistor R4 and across the meter shunt MSH-1.

Resistor R4 serves to match the one milliamp ( $55\ \Omega$ ) meter movement with the 100 mV 500 A shunt which is common to Ling large FPS units.

The meter scale is calibrated in dc amperes and has a full-scale reading of 300 A dc.

#### 3.1.9 Options

The optional equipment and circuits shown on Figure 2-4, are available as options and must be ordered as such. See Section VI for further details.







## SECTION VI

### MAINTENANCE

#### 4.1 GENERAL

The Ling Model PSE-300 has been designed to provide troublefree service over long periods of time and should not require any checks or adjustments other than those checks, inspections, and preventive maintenance listed in paragraph 4.4.

#### 4.2 TOOLS AND EQUIPMENT

The following instruments and tools are adequate for installing, testing, and troubleshooting the Ling FPS.

- a. Multimeter, Simpson Model 260, or equivalent
- b. Standard hand tools, i.e., screwdrivers, soldering iron, pliers, etc.

#### 4.3 TROUBLESHOOTING

Should difficulties occur, use standard power supply troubleshooting techniques to locate the trouble. Refer to Figures 2-4, 2-2, and 2-1, and conduct point-to-point resistance measurements to locate the opened or shorted component. Conduct point-to-ground voltage measurements to locate open or shorted components.

#### CAUTION

Observe caution when making voltage measurements. The three-phase input voltage is LETHAL.

Ensure that external operating power is removed from the unit before making resistance measurements.

Table 4-1 lists various system problems with symptoms and suggested remedies. Table 4-2 lists approximate voltage and resistance readings across major points in the unit.

#### WARNING

Ensure that external operating power is removed from the system before making any resistance checks!



Table 4-1. PSE-300 Possible Troubles, Possible Causes, and Corrective Action

| Item | Symptoms                                                                                     | Possible Cause                                                                 | Corrective Action                                                |
|------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------|
| 1    | SSPA will not energize.                                                                      | Loose connection or open wire.                                                 | Check wiring connections and wires. Correst as required.         |
|      |                                                                                              | Defective control relay (CR) in the FPS.                                       | Replace defective relay.                                         |
|      |                                                                                              | Defective delay relay (DR).                                                    | Replace defective relay.                                         |
|      |                                                                                              | Open reistor R1.                                                               | Replace defective resistor.                                      |
|      |                                                                                              | Open rectifiers.                                                               | Replace rectifiers.                                              |
| 2    | Increase in normal amplifier current (caused by excessive ripple on the FPS output voltage). | Open power transformer.                                                        | Replace transformer.                                             |
|      |                                                                                              | Loss of one phase of operating power to the FPS. (Most probably a blown fuse.) | Check fuses F1, F2, and F3, Figure 2-3, and replace as required. |
|      |                                                                                              | Defective filter capacitor C1 or open surge resistor R2 and R3.                | Check and replace defective component.                           |
|      |                                                                                              | Open rectifier.                                                                | Check and replace defective rectifier.                           |
|      |                                                                                              | Defective transformer or open rectifiers.                                      | Check and replace as required.                                   |
| 3    | Loss of Shaker Field                                                                         | Control switch in BYPASS position.                                             | Change control switch to ON.                                     |



Table 4-2. Point-to-Point Resistance and Voltage Measurements

| Item | From                            | To                              | Approximate Value (ohm) |  | Figure | Comment                                                                  |
|------|---------------------------------|---------------------------------|-------------------------|--|--------|--------------------------------------------------------------------------|
|      |                                 | RESISTANCE                      |                         |  |        |                                                                          |
| 1    | One side of control relay coil. | Other side of same coil.        | 100                     |  | 2-2    | Remove external connection from one side of coil.                        |
| 2    | F1                              | F2                              | 0                       |  | 2-2    | Too small to read with 260.                                              |
| 3    | F2                              | F3                              | 0                       |  | 2-2    |                                                                          |
| 4    | F1                              | F3                              | 0                       |  | 2-2    |                                                                          |
| 5    | F1                              | TB1-E                           | 500/30 000              |  | 2-2    | Dual readings indicate reversal of leads on the ohmmeter.                |
| 6    | F2                              | TB1-E                           | 500/30 000              |  | 2-2    |                                                                          |
| 7    | F3                              | TB1-E                           | 500/30 000              |  | 2-2    |                                                                          |
| 8    | F1                              | TB1-F                           | 400/30 000              |  | 2-2    |                                                                          |
| 9    | F2                              | TB1-F                           | 400/30 000              |  | 2-2    | Disconnect external circuit from TB1-E for steps 11, 12, 13, 14, and 15. |
| 10   | F3                              | TB1-F                           | 400/30 000              |  | 2-2    |                                                                          |
| 11   | TB1-E(+)                        | TB1-F(-)                        | 1350/20 000             |  | 2-2    |                                                                          |
| 12   | TB1-E                           | One side of coil of Relay (FR). | 7000                    |  | 2-2    |                                                                          |
| 13   | TB1-E                           | Other side of FR coil.          | 0                       |  | 2-2    |                                                                          |
| 14   | TB1-E                           | C1(+)                           | 10 000                  |  | 2-2    |                                                                          |
| 15   | TB1-E                           | Chassis Ground                  | Infinity                |  | 2-2    |                                                                          |



Table 4-2. Point-to-Point Resistance and Voltage Measurements (Cont.)

| Item | From                          | To                            | Approximate Value (ohm) | Figure | Comment |
|------|-------------------------------|-------------------------------|-------------------------|--------|---------|
| 16   | L1 on thermal overload relay, | T1 on thermal overload relay. | 0                       | 2-2    |         |
| 17   | L2 on TOR                     | T2 on TOR                     | 0                       | 2-2    |         |
| 18   | L3 on TOR                     | T3 on TOR                     | 0                       | 2-2    |         |
| 19   | TB1-E (+)                     | VOLTAGE                       |                         | 2-2    |         |
|      |                               | TB1-F (-)                     | 450 Vdc                 |        |         |
|      |                               | Other side of FR coil.        | 48 Vdc                  |        |         |
| 20   | One side of FR coil.          |                               |                         | 2-2    |         |



#### 4.4 PREVENTIVE MAINTENANCE

The simplicity of the Ling PS-300 FPS permits long periods of operation without preventive maintenance. However, it is recommended that the unit be inspected at least every 90 days and cleaned with a vacuum cleaner which has nonconductive attachments. All leads and connections should be checked periodically for tightness. High current leads should be loosened and retightened to ensure good contact.

#### 4.5 CALIBRATION

Calibration and/or adjustments are not required.







## SECTION V

### SUPPORT DOCUMENTATION

#### 5.1 ENGINEERING DRAWINGS

The following Ling engineering drawings are shipped with the Model PS/PSE-300 Field Power Supply. Model PS-300 designates the field power supply without enclosure, and PSE-300 designates the field power supply with enclosure.

|        |                                   |
|--------|-----------------------------------|
| 705085 | Schematic Power Supply PS/PSE-300 |
| 705083 | Installation Drawing PS/PSE-300   |
| 705067 | Assembly PSE-300                  |
| 709295 | Assembly PS-300                   |

#### 5.2 ENGINEERING PARTS LIST

The following Ling engineering parts list is shipped with the Model PS/PSE-300 Field Power Supply.

|          |                                  |
|----------|----------------------------------|
| PL705067 | Model PSE-300 Field Power Supply |
| PL709295 | Model PS-300 Field Power Supply  |







## SECTION VI

### OPTIONS

The following options are available, by special order, on the Ling Model PS/PSE-300 Field Power Supply.

#### 6.1 TWENTY-FOUR INCH CABINET

This option provides a 24-inch equipment cabinet instead of the standard 19-inch cabinet provided with the standard units.

#### 6.2 REMOTE FIELD CURRENT METER

This options provides terminal blocks, fuse blocks, and fuses as shown on Ling drawing 705085. An additional meter mounting panel with current and voltage meters is available for remote mounting.

#### 6.3 208 TO 240 V, THREE-PHASE, 50/60 HZ OPERATION

This option provides a size 3 main power contactor for the FPS and a Ling Model PT-1271 Main Power Transformer.

#### 6.4 380 V, THREE-PHASE, 50 HZ OPERATION

This option provides a Ling Model PT-1271 Main Power Transformer.

#### 6.5 POWER ACCESSORY KIT FOR 440 TO 500 VAC OPERATION

This option provides a 60 A, 600 V fused disconnect and three each 35 A, 600 V, dual-element fuses to be used as shown in Figure 2-3.

#### 6.6 POWER ACCESSORY KIT FOR 380 VAC OPERATION

This option provides a 60 A, 600 V fused disconnect and three each 45 A, 600 V, dual-element fuses to be used as shown in Figure 2-3.

#### 6.7 POWER ACCESSORY KIT FOR 208 TO 240 VAC OPERATION

This option provides a 100 A, 600 V fused disconnect and three each 80 A, 600 V, dual-element fuses to be used as shown in Figure 2-3.





